CHAPTER 9

Management of Safety and Emergencies

This chapter sets out the principles and recommended practices for controlling health and safety hazards on board a tanker. It introduces a risk-based approach to the planning and execution of hazardous work, following the principles set out in the *International Safety Management (ISM) Code*.

It gives guidance on risk assessment and risk management processes and provides information on the practical application of these processes for managing hot work and other hazardous tasks on board.

Safety extends to the activities of contractors and repair teams working on board. Issues relating to the safe management of contractors and repair work outside a shipyard are addressed.

Finally, advice is provided on the emergency management structure and organisation to facilitate effective responses to emergencies.

9.1 The International Safety Management (ISM) Code

All tankers, as defined in the *International Convention for the Safety of Life at Sea (SOLAS)* and the *International Convention for the Prevention of Pollution from Ships (MARPOL)*, of 500 tonnes DWT and over are required to comply with the ISM Code. Ships that the ISM Code does not apply to are encouraged to develop a management system that provides an equivalent standard of safe operations.

Under the ISM Code, safety management processes are based on risk assessments and risk management techniques (see chapter 4).

The purpose of the ISM Code is to provide an international standard for safely managing and operating ships and for preventing pollution.

The ISM Code requires ship operators to:

- Provide safe practices in ship operation and a safe working environment.
- Establish safeguards against all identified risks.
- Continuously improve the safety management skills of the ship's crew and shore personnel, including preparing for emergencies related to safety and environmental protection.

The ISM Code defines a ship operating company and requires it to develop a Safety Management System (SMS), which should include certain functional requirements, particularly *"instructions and procedures to ensure safe operation of ships and protection of the environment"*.

The ISM Code is not prescriptive about how a ship is managed. It is left to the operator to develop the SMS elements suitable to the operation of a specific ship.

In developing their SMS, operators are encouraged to refer to applicable industry publications and guidelines.

The International Maritime Organization's (IMO) guidelines for the ISM Code identify that cargo loading and discharge operations, including those related to dangerous goods, should be included in the scope of the operator's documentation.

9.2 Safety Management Systems

The SMS enables effective implementation of the operator's health, safety and environmental protection policy. Regular audits of the SMS verify its suitability to deliver the requirements of the ISM Code and to confirm that it is effective and that stated procedures are being followed. OCIMF's Tanker Management and Self Assessment (TMSA) is an example of a system that offers the opportunity to verify system effectiveness via self assessment and also promotes continual improvement.

Although the ISM Code specifies a range of safety management topics, the operator should develop the content and form of its SMS. This should show that acceptable levels of safety management are in place to protect the ship, its personnel and the marine environment.

To deliver the required levels of safety, the SMS needs to address all activities undertaken in the operation of the ship, together with the possible situations that could affect its safety or operation.

These activities and situations will involve varying degrees of hazard to the ship, its personnel and the environment. Careful assessment of these hazards, and the probability of their occurrence, will determine the severity of the risks involved. Risk management tools can then be applied to ensure safe completion of the work and compliance with the SMS and provide the objective evidence needed for verification, such as:

- Documented policies, procedures and instructions.
- Documentation of the verification of day to day operation that is carried out by the Responsible Person, relevant to ensure compliance.

The result of an effective SMS is a safe system of work.

Refer to the latest edition of the International Chamber of Shipping's (ICS) *Guidelines on the Application of the IMO International Safety Management (ISM) Code*.

9.3 Work planning and permit to work systems

While operators will develop their own procedures for managing all aspects of operations and tasks, many choose to incorporate work planning meetings and a permit to work system into their SMS to manage hazardous tasks.

Refer to section 4.7, which provides further guidance on these topics.

9.4 Hot work

Hot work has caused fires and explosions in, on or near cargo tanks or other spaces that contained, or have previously contained, flammable substances or substances that emit flammable vapours. In such spaces, hot work should be considered only if there are no alternative means of repair.

9.4.1 Definition of hot work

Hot work is any work that involves sources of ignition or temperatures high enough to ignite a flammable gas or liquid or material. This includes, but is not limited to:

- Welding (electric arc or gas).
- Cutting, burning, gouging (electric or gas).
- Heating (blow torch or heat gun).
- Soldering (electric or blow torch).

Use of the following temporary/portable equipment in a hazardous area should be classed as hot work:

- Power tools (electric or electric power tools).
- Non-intrinsically safe electronic equipment.
- Internal combustion engines (driving air compressors, pumps, pressure washers, etc.).

9.4.2 Control of hot work

The SMS should include adequate guidance on the control of hot work and should be robust enough to ensure compliance (see section 9.2). An absence of guidance should be taken to mean work is prohibited rather than approved.

Welding should only be carried out in ventilated areas. If exposure controls are not adequate, workers should wear suitable Respiratory Protective Equipment (RPE) to minimise the risk from the residual fumes.

9.4.3 Hot work inside a designated space

A space where conditions are safe for hot work should be designated, such as the engine room workshop. Whenever possible, hot work should be carried out in that space.

The designated space should be assessed for possible risks and the SMS should define the conditions for carrying out hot work in that space, including additional controls such as notifications, fire watches or restrictions. Hot work should be prohibited during bunkering, cargo operations, Crude Oil Washing (COW), tank cleaning operations and whenever cargo tank vapours are released. If it is necessary for hot work to be done, these operations should stop until the hot work is completed.

For hot work such as electric welding (see section 9.5) or gas cutting, establish a safety boundary inside the designated space to prevent arc flash and contain sparks. This area should be bound by curtains or another barrier. Other factors, such as fuel tanks or electric cables, may also require a safety boundary. Work outside the boundary, but inside the designated space, may be allowed with additional controls identified by a risk assessment or as part of the operator's SMS procedures.

If the designated hot work area includes a bunker tank bulkhead, the work should not be allowed within 500mm of that bulkhead (see section 9.4.5.1).

9.4.4 Hot work outside a designated space

9.4.4.1 General

Hot work done outside the designated space should be controlled under the SMS by a permit to work system and defined requirements as in section 9.2.

Figure 9.5 shows how guidance for hot work on an inerted ship may be presented in an SMS. This is an example for operators to tailor to their own requirements.

A flowchart for guidance is in figure 9.5. The flowchart assumes the work is considered essential for safety or the immediate operational capability of the ship, and that it cannot be deferred until the next planned visit to a repair yard.

The Master should initially decide whether hot work is justified and whether it can be done safely. The departmental heads should assess all proposed work within their departments before the work starts.

A risk assessment should identify the hazards and the risks involved. This will produce risk-reduction measures that need to be taken to allow the work to be done safely.

The risk assessment should identify hazards to fire watch personnel and how they will be evacuated in an emergency. It should also identify the extra Personal Protective Equipment (PPE) that will ensure risk levels are acceptable.

A written plan for undertaking the work should be completed, discussed and agreed by everybody who has responsibilities connected to the work.

This plan should define the preparations needed before work starts, the procedures for carrying out the work and the safety precautions. The plan should also identify the person authorising the work and the personnel responsible for carrying out the specified tasks, including contractors (see section 9.7).

A designated Responsible Officer not directly involved in the hot work should ensure that the plan is followed.

Personnel carrying out the work should be adequately trained and competent to carry it out safely and effectively.

The usual resource limitations on board a tanker mean that only one hot work operation at a time should be carried out. A separate hot work permit should be approved for each intended task and location.

The work area should be carefully prepared and secured before hot work starts.

Fire safety precautions and fire-extinguishing measures should be reviewed. Adequate firefighting equipment should be prepared, laid out and be ready for immediate use.

Fire watch procedures should be established for the area of hot work and for adjacent spaces where heat transfer or accidental damage might create a hazard, e.g. damage to hydraulic lines, electrical cables, thermal oil lines, etc. The fire watch should monitor the hot work and act if residues or paint coatings ignite. Effective ways to contain and extinguish welding sparks and molten slag should be established.

The atmosphere of the area should be tested and be less than 1% Lower Flammable Limit (LFL).

The hot work permit should be issued just before the work is to be done. If the start of the work is delayed, all safety measures should be rechecked and recorded before it begins.

Permits are issued under specific conditions, but if these change hot work should stop immediately. The permit should be withdrawn or cancelled until all conditions and mitigations have been checked and reinstated, allowing the permit to be re-issued or re-approved.

The work area should be adequately and continuously ventilated and the frequency of atmosphere monitoring should be established. Times and results of atmosphere monitoring should be recorded on the hot work permit.

Isolation of the work area and fire safety precautions should continue until the risk of fire no longer exists.

If hot work needs to be done in a dangerous or hazardous area (see section 9.4.5) when alongside a terminal, it should be permitted only in line with prevailing national or international regulations, port and terminal requirements and after obtaining all necessary approvals.

9.4.4.2 Hot work in a gas safe area

A dedicated area outside the engine room may be considered for hot work, e.g. on the poop deck aft of the accommodation and well clear of any oil tank vents. Such an area should be marked accordingly. Any work at this location should have a risk assessment and the precautions set out in section 9.4.4.1 should be taken.

9.4.4.3 Hot work inside the machinery space

Hot work in the main machinery space should have a risk assessment and the precautions set out in section 9.4.4.1 should be taken.

When the hot work is associated with fuel tanks and fuel pipelines, consider the potential for hydrocarbon vapours in the atmosphere and the existence of ignition sources.

No hot work should be carried out on or within 500mm of bunker tanks unless that tank is cleaned to meet the requirements in section 9.4.5.1. A risk assessment should cover any proximity to fuel or other hydrocarbon piping.

9.4.4.4 Hot work over the side

Hot work on the outside hull, that does not fall within the dangerous or hazardous areas described in section 9.4.5, may present unique hazards and should be risk assessed before the work starts. Examples are hot work on anchors or chains (from a barge or other vessel) or the aft area of the hull for stern seal or propeller work. The procedures outlined in section 9.8 should be followed, with particular attention to section 9.10.13.

Hot work that would be conducted on the hull, such as ballast or other tanks within the cargo tank area, is to be treated as work in dangerous or hazardous areas (see section 9.4.5). When work is done over the side, the SMS may require additional permits.

9.4.5 Hot work in dangerous or hazardous areas

9.4.5.1 General

Dangerous or hazardous areas are those locations on board or within the terminal where an explosive atmosphere could be present (as defined in section 4.11.2). For ships, this effectively means an area larger than the cargo tank deck, which includes cargo tanks, ballast tanks, pumprooms and the atmospheric space around and above them. No hot work should be done in a dangerous or hazardous area until it has been made safe, tested and all appropriate approvals obtained.

Hot work in a dangerous or hazardous area should be subject to a risk assessment and the guidance in section 9.4.4 followed. The potential for hydrocarbon vapours and ignition sources should be considered.

Hot work in dangerous or hazardous areas should only be carried out when the ship is in ballast. Hot work should be prohibited during cargo operations and when tank cleaning, gas freeing, purging or inerting. If hot work needs to be interrupted to carry out any of these operations, the permit should be withdrawn or cancelled. On completion of the operation, all safety checks should be carried out once more and the permit reapproved or a new procedure developed.

Where hot work involves entry into an enclosed space, follow the procedures in chapter 10. A compartment where hot work is to be done should be cleaned and ventilated. Particular attention should be given to the condition of any adjacent spaces.

Adjacent fuel oil bunker tanks may be considered safe if tests give readings of less than 1% LFL in the vapour space of the bunker tank. No hot work should be carried out on bulkheads of bunker tanks, or within 500mm of such bulkheads, unless that tank has been cleaned for hot work.

Adjacent ballast tanks and compartments, other than cargo tanks, should be checked to ensure they are gas free and safe for hot work. If they are found to contain hydrocarbon liquid or vapours, they should be cleaned and gas freed or inerted.

9.4.5.2 Hot work in cargo tanks

Sludge, cargo impregnated scale, sediment or any other material likely to give off flammable vapour should be removed from the work area. The extent of the cleaned area should be established following a risk assessment of the work to be done. The opposite sides of frames and bulkheads need special attention. Other areas that the hot work may affect, e.g. immediately below the work location, should also be cleaned.

Table 9.1 shows the safe distance for areas to be cleaned and the minimum requirements that may need to be extended based on the results of the risk assessment. Cleaning distances are based on the type of work and the height above the tank bottom.

Consider using fire resistant blankets or putting a water bottom in the tank to prevent sparks falling onto coatings.

All cargo pipelines to other compartments should be flushed through with water, drained, vented and isolated from the compartment where hot work will take place. They may be subsequently inerted or completely filled with water.

Height of work area	Operator's side			Opposite side		
	Gas cut	Welding	Gouging	Gas cut	Welding	Gouging
0–5 metres	1.5m	5.0m	5.0m	7.5m	2.0m	2.0m
5–10 metres	1.5m	5.0m	5.0m	10.0m	2.0m	2.0m
10–15 metres	1.5m	5.0m	7.5m	15.0m	2.0m	2.0m
>15 metres	1.5m	5.0m	10.0m	20.0m	2.0m	2.0m

Table 9.1: Radius of areas to be cleaned in preparation for hot work in tanks

Heating coils should be flushed or blown through with steam to ensure they are clear of hydrocarbons.

An adjacent fuel oil bunker tank may be considered safe if tests give a reading of less than 1% LFL in the vapour space. No hot work should be carried out on bulkheads of bunker tanks or within 500mm of the bulkheads unless that tank has been cleaned for hot work.

Tankers without an Inert Gas system

The compartment where hot work is to be done should be cleaned, gas freed to meet hot work requirements and continuously ventilated.

Adjacent cargo tanks, including those positioned diagonally, should either have been cleaned and gas freed to meet hot work requirements or completely filled with water.

All slops should be either removed from the ship or securely isolated in a closed and non-adjacent tank at least 30m from the hot work location. For this purpose, tanks located diagonally should be regarded as adjacent tanks. A non-adjacent slop tank should be kept closed, securely isolated from the vent main and isolated from the piping system for the duration of the hot work.

Vapour or vent lines to the compartment should be ventilated to not more than 1% LFL and then isolated.

The possibility of using an external source of Inert Gas (IG) should be considered.

Tankers with an Inert Gas system

The compartment where the hot work is to be done should be cleaned, gas freed to meet hot work requirements and continuously ventilated.

Adjacent cargo tanks, including those positioned diagonally, should be either:

- Cleaned and gas freed, with hydrocarbon vapour content reduced to not more than 1% LFL and maintained at that level.
- Emptied, purged and the hydrocarbon vapour content reduced to less than 2% by volume and inerted.
- Completely filled with water.

All other cargo tanks should be inerted and their deck openings closed.

When hot work is to be carried out on a cargo tank bulkhead, or within 500mm of such a bulkhead, the space on the other side should also be cleaned to meet hot work requirements.

IG pressure should be reduced for the duration of the hot work to prevent uncontrolled venting.

Cargo piping and IG lines to the compartment should be purged with IG, to reduce the hydrocarbon level to less than 2% by volume, and isolated.

All slops should be removed from the ship or securely isolated in a non-adjacent tank at least 30m from the hot work location.

A non-adjacent slop tank should be kept closed, securely isolated from the IG main and isolated from the piping system for the duration of the hot work.

Gas testing should be done before starting hot work and there should be continuous monitoring of the atmosphere in the vicinity during the entire duration of hot work.

9.4.5.3 Hot work in ballast tanks

Ballast tanks located in the cargo tank area should be treated as dangerous or hazardous areas, similar to cargo tanks.

Hot work in ballast tanks, e.g. the fore peak and after peak tanks, that fall outside the dangerous or hazardous area and have no adjacent cargo, slop or bunker tanks, may be treated as work outside a designated space, but no hot work should be carried out unless all spaces within 30m are either:

- Gas freed.
- Hydrocarbon vapour content reduced to 2% by volume and inerted.
- Completely filled with water.

9.4.5.4 Hot work in pumproom

The pumproom should be treated as a dangerous or hazardous area, similar to cargo tanks.

Adjacent tanks should be either:

- Cleaned and gas freed, with hydrocarbon vapour content reduced to not more than 1% LFL and maintained at that level.
- Emptied, purged and the hydrocarbon vapour content reduced to less than 2% by volume and inerted.
- Completely filled with water.

Pipelines, strainers and cargo pumps should be gas freed, inerted or filled with water. The bilge and work areas should be cleaned to meet hot work requirements.

All slops should be either removed from the ship or securely isolated in a non-adjacent tank at least 30m from the hot work location.

9.4.5.5 Hot work within the cargo tank deck area

On the tank deck

Any hot work on the tank deck or less than 500mm above the tank deck should be classed as hot work within that tank, so it will need to comply with the appropriate measures (see section 9.4.5.2).

On the cargo tank bulkhead or within 500mm of the bulkhead:

- The space on the other side should also be cleaned to meet hot work requirements.
- Reduce IG pressure for the duration of the hot work to prevent uncontrolled venting.
- Cargo piping and IG lines to the compartments should be purged with IG to not more than 2% hydrocarbon by volume and then isolated.
- All slops should be either removed from the ship or securely isolated in a non-adjacent tank at least 30m from the hot work location.

Above the tank deck

If hot work is to be done above the tank deck (higher than 500mm), any cargo and slop tanks within a radius of at least 30m around the working area should be either:

- Cleaned and gas freed, with hydrocarbon vapour content reduced to not more than 1% LFL and maintained at that level.
- Emptied, purged and the hydrocarbon vapour content reduced to less than 2% by volume and inerted.
- Completely filled with water.

All other cargo tanks should be inerted with openings closed.

All slops should be either removed from the ship or isolated in a tank as far from the hot work location as is practicable.

Alternatively, for tankers without an Inert Gas system

All cargo tanks within 30m of the work location, including those positioned diagonally, should be either cleaned and gas freed to hot work standard or completely filled with water.

All slops should be either removed from the ship or securely isolated in the tank furthest (and at least 30m) from the hot work location. Vapour or vent lines to the compartment should be ventilated to not more than 1% LFL and then isolated.

The possibility of using an external source of IG should be considered.

9.4.5.6 Hot work in the vicinity of bunker tanks

Hot work near bunker fuel tanks should be treated in the same way as hot work on or above the tank deck. No hot work should be carried out on the deck, or within 500mm of the deck, unless the tank has been cleaned to meet hot work requirements.

Bunker fuel tanks should be clearly identified to avoid any misunderstanding about their location and extent.

9.4.5.7 Hot work on pipelines

Sections of pipelines, strainers, valves, etc. should be removed from the system and repaired in the designated space whenever possible (see section 9.4.3). Any breaking of lines should comply with the permit to work system for the control of hazardous energy.

Where repairs on pipelines and valves need to be done with the equipment in place, the item needing hot work should be removed by cold work and the remaining pipework blanked off. The item should be cleaned and gas freed to meet hot work permit requirements.

If the location where the hot work is to be done is not close to the disconnected pipeline, consider providing continuous through ventilation of the pipeline with fresh air and monitoring the exhaust air for hydrocarbon vapour.

Heating coils should be flushed or blown through with steam to ensure they are clear of hydrocarbons.

9.4.5.8 Hot work diagrams

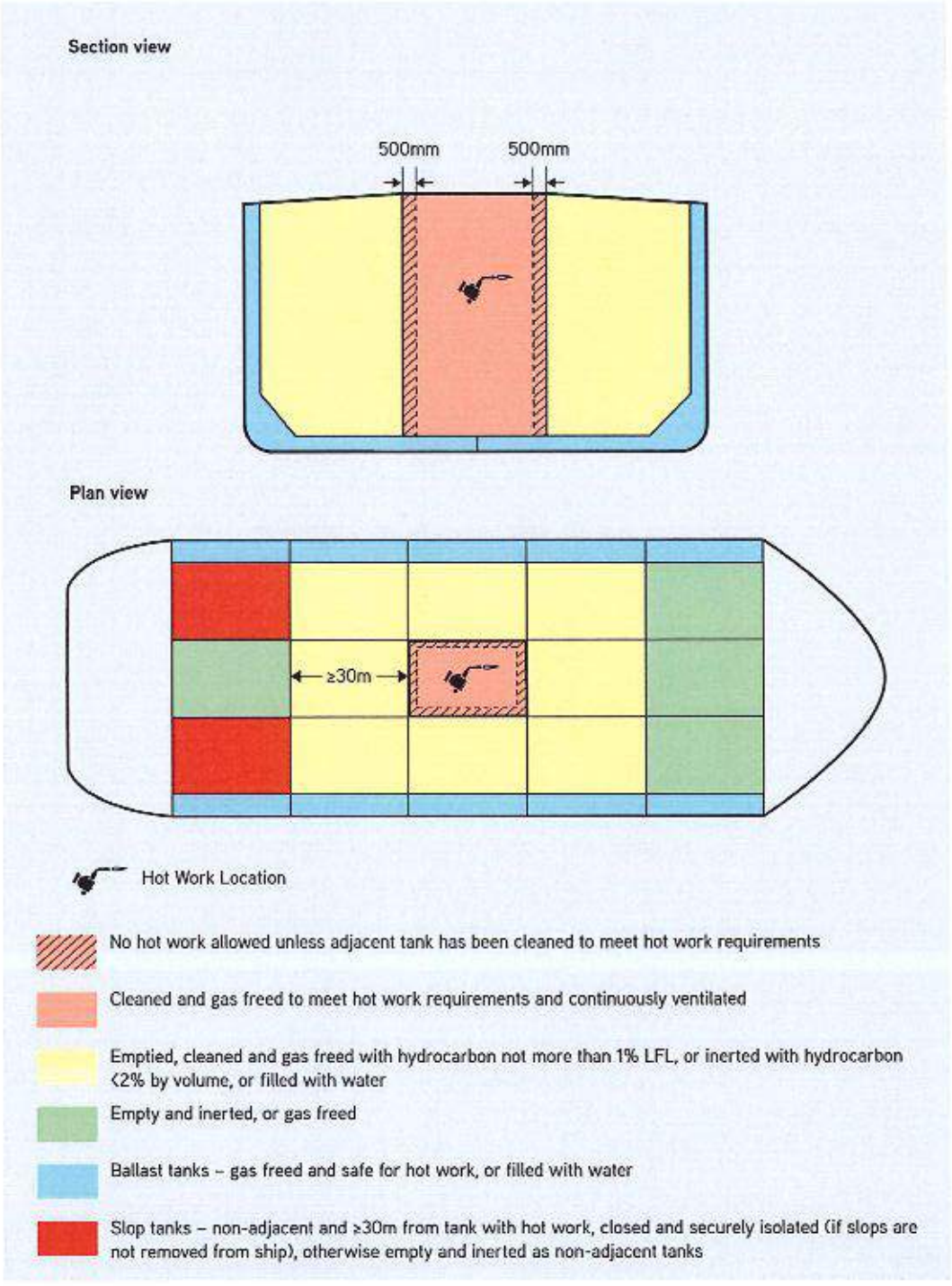

Figure 9.1: Hot work being carried out in a cargo tank

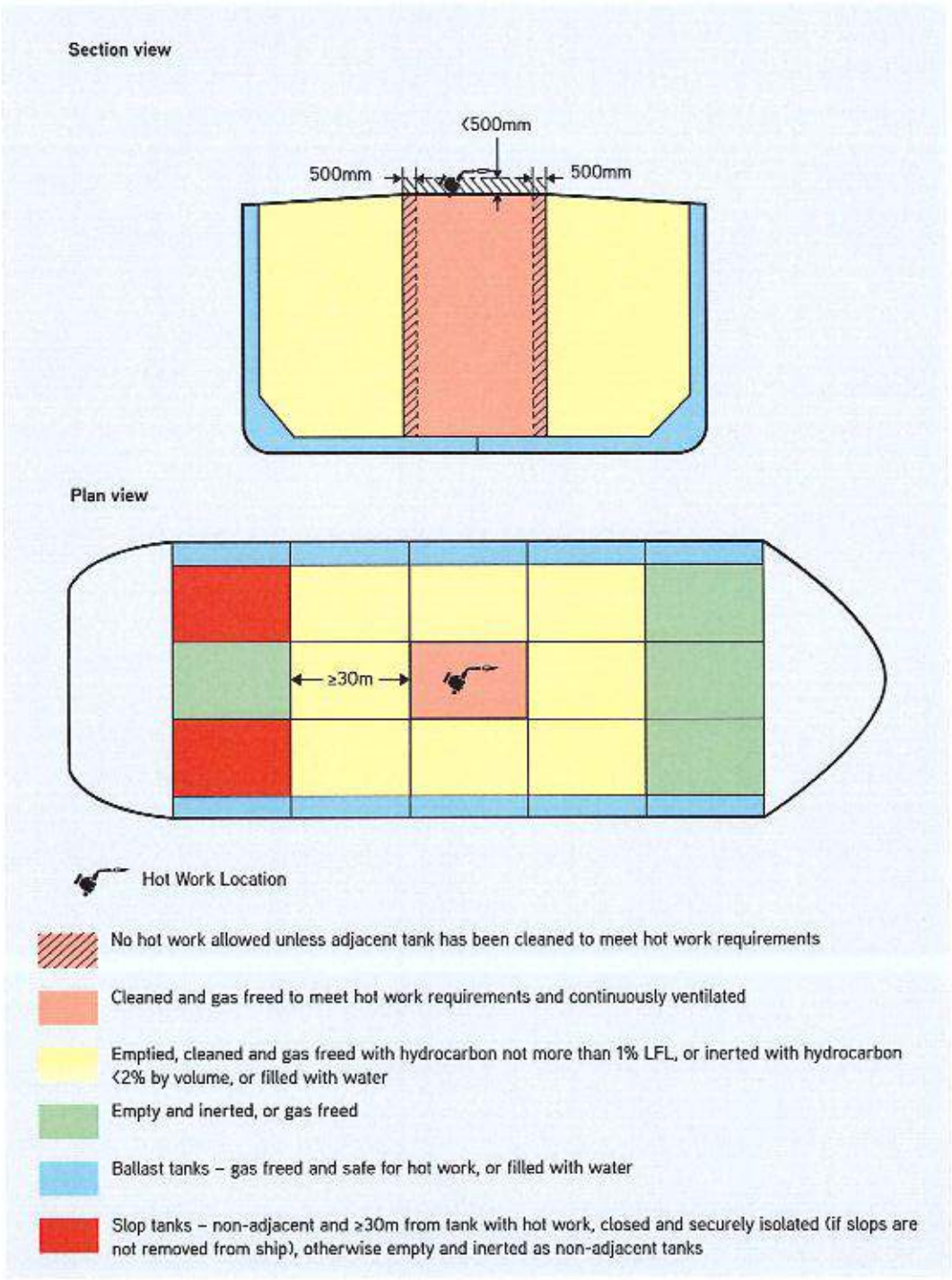

Figure 9.2: Hot work being carried out on cargo tank deck or within 500mm of it (to be treated as hot work in tank)

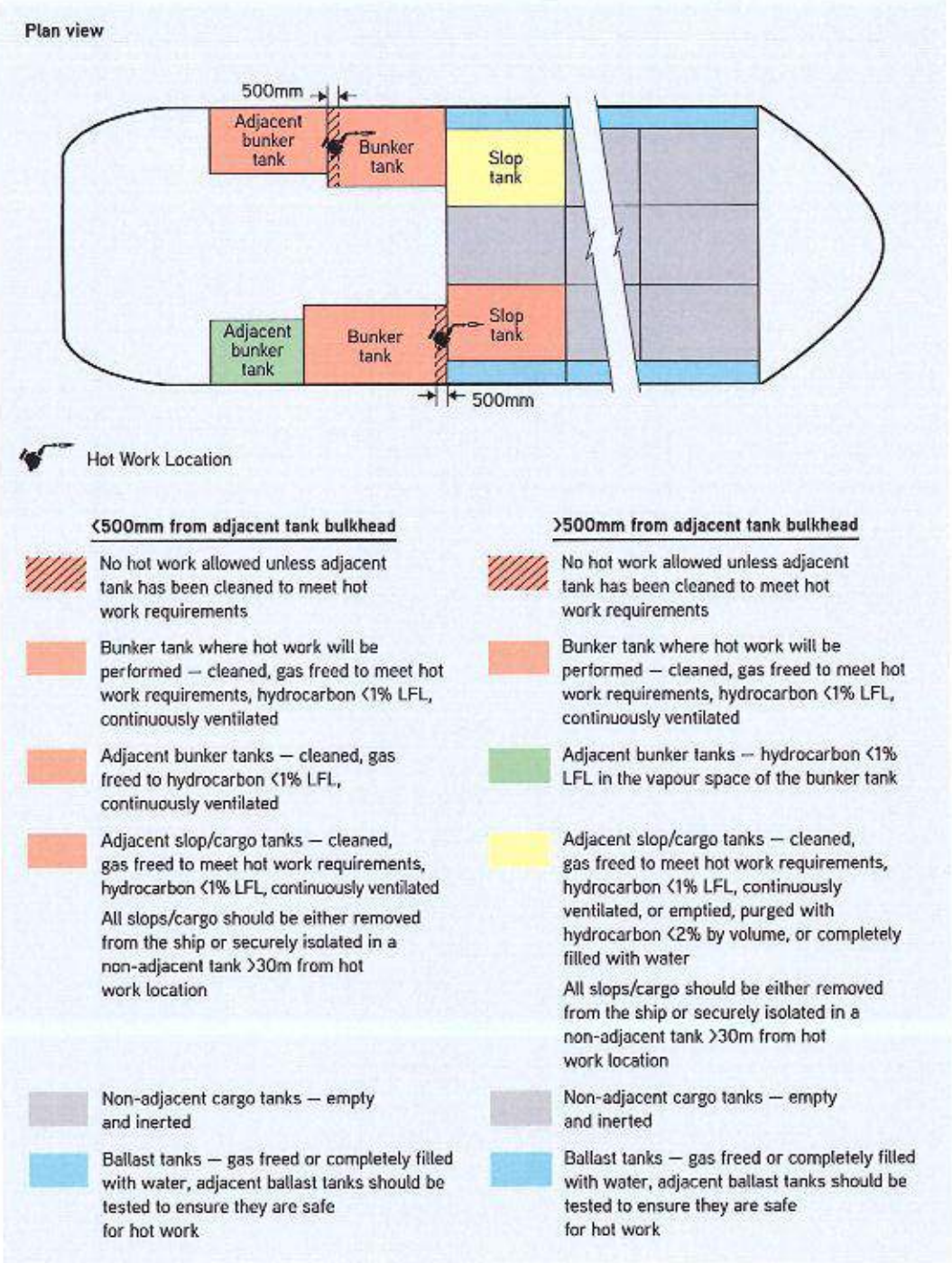

Figure 9.3: Hot work inside a bunker tank

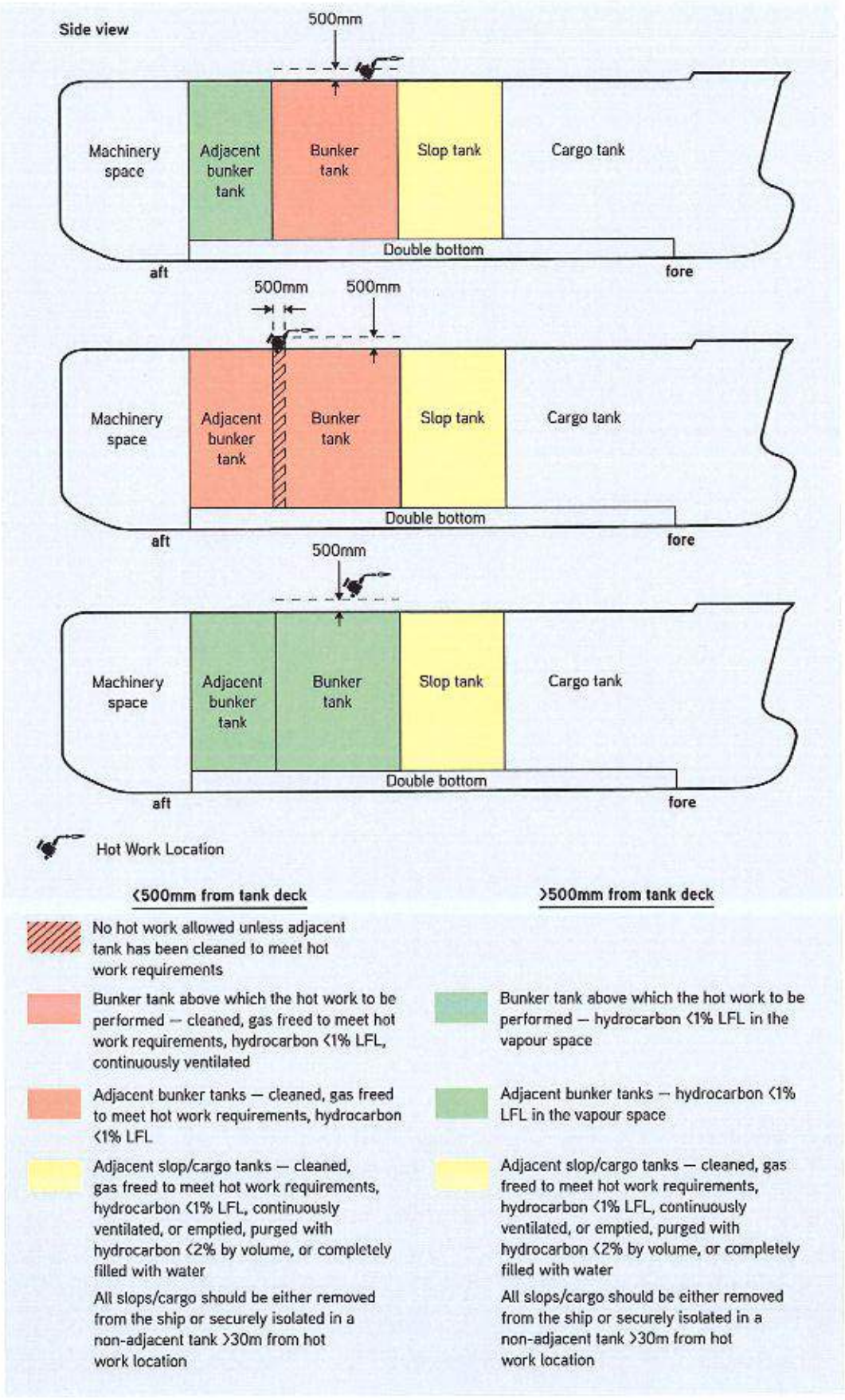

Figure 9.4: Hot work in the vicinity of a bunker tank (treated as hot work over tank deck)

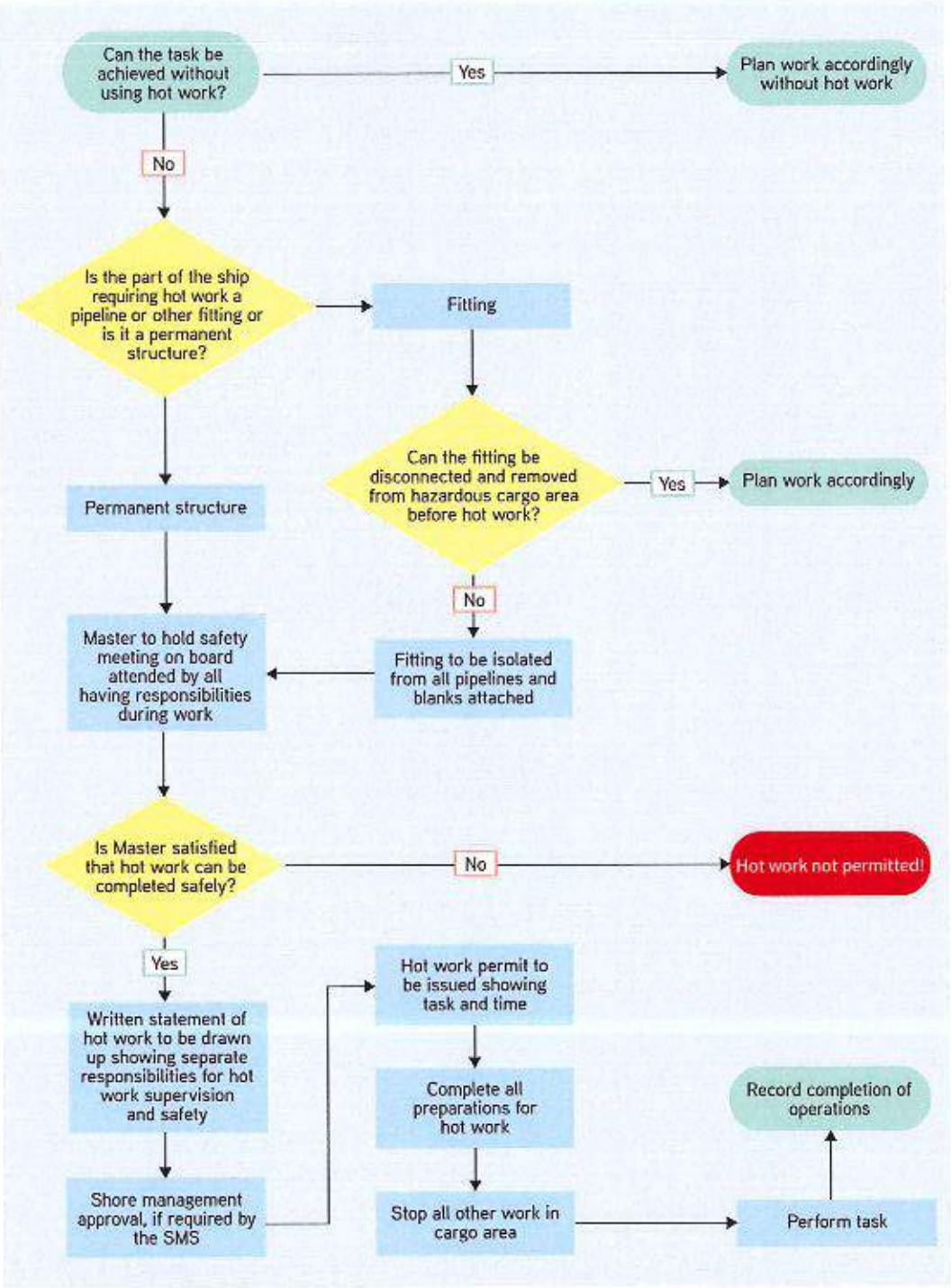

Figure 9.5: Hot work flowchart

Work location minimum requirements	Engine room workshop	Other parts of non-hazardous area	Open deck aft of accommodation	Enclosed spaces (other than pumprooms)	Main deck (deck plating)	Work on fixtures/fittings in the main deck area	Work on any cargo related pipelines including heating coils in a cargo tank	Cargo pumprooms	Cargo or ballast tanks
Work planning meeting to be held and risk assessment completed	✔	✔	✔	✔	✔	✔	✔	✔	✔
Work in designated space with shield or curtain erected	✔								
Adequate ventilation	✔	✔		✔			✔	✔	✔
Confirmation from Master or designate that work is OK to proceed	✔								
Tank atmosphere checks carried out and entry permit issued				✔			✔		✔
Tank to be washed and gas freed					✔		✔		✔
Cargo tanks to be purged and inerted to not more than 8% oxygen and not more than 2% hydrocarbon					✔	✔	✔	✔	✔
Work to be carried out further than 500mm from the tank deck or bulkheads				✔		✔		✔	
Work to be carried out more than 500mm from a fuel oil tank deck or bulkheads			✔	✔		✔		✔	
Local cleaning to be carried out as per requirements				✔			✔	✔	✔
All interconnecting pipelines flushed and drained							✔	✔	✔
Tank valves isolated							✔	✔	✔
Hot work permit to be issued on board		✔							
Hot work permit issued in agreement with company			✔	✔	✔	✔	✔	✔	✔
Hot work permit approved by Master or Responsible Officer		✔	✔	✔	✔	✔	✔	✔	✔

Figure 9.6: Example of SMS guidance for hot work on an inerted ship

9.5 Electric welding equipment

Electric welding equipment should be carefully inspected before each use to ensure it is in good condition. If necessary, it should be correctly earthed. When using electric arc equipment, pay special attention to ensure:

- Electrical supply connections are made in a gas free space.
- Existing supply wiring is adequate to carry the electrical current demand without overloading, causing heating.
- Insulation of flexible electric cables is in good condition.
- Cable route to the work site is the safest possible, only passing over gas freed or inerted spaces.
- Earthing connection is next to the work site and the earth return cable leads directly back to the welding machine. The ship's structure should not be used as an earth return.

9.6 Other hazardous tasks

A hazardous task is defined as anything other than hot work that presents a hazard to the ship, terminal or personnel and that needs to be controlled by a risk assessment process, e.g. a permit to work system.

A work permit or controlled procedure should be developed and approved for each hazardous task. The permit or controlled procedure should follow the process in sections 9.3 and 4.7 and should be discussed with the personnel performing the task.

The procedure, approval and record of compliance should be kept with the SMS records.

While a ship is alongside a terminal, hazardous tasks should only be undertaken with the prior agreement of the Terminal Representative.

Examples of such tasks are:

- Enclosed space entry.
- Tank inspections.
- Diving operations.
- Blanking sea chests.
- Work on critical equipment and systems.
- Extended work aloft or over the side.
- Electrical work.
- Heavy or unusual lifting operations.
- Work on or next to a pressurised system.
- Testing and launching of lifeboats.

9.7 Management of contractors

The Master should be satisfied that when contractors or work gangs are employed, arrangements are made to ensure they understand and comply with all relevant safe working practices. A formal safety induction should be completed. A Responsible Officer should supervise and control contractors. The ship's crew should inspect contractors' equipment, which should also have the necessary certificates.

The contractors should take part in relevant safety meetings to discuss the arrangements for work. Where applicable, contractors should sign the formal approval relevant to the work, including

any relevant permits to work, verifying they are aware of the hazards and safety precautions required to reduce the risks to an acceptable level.

The ship remains responsible for approving and completing any work permits required before or during contractor work.

9.8 Managing Simultaneous Operations

Simultaneous Operations (SIMOPS) are activities that take place at the same time in the same area or that could directly or indirectly affect the safety of any other activity on the ship or terminal.

SIMOPS should be identified early to understand the impact one operation has on the other.

They should be discussed during work planning meetings (see section 4.7.5). A risk assessment is needed to identify the hazards and control measures.

The risk assessment should look include:

- Schedule clashes.
- Resources.
- Supervision.
- Distraction.
- Communications.
- Skills.
- Fatigue.
- Critical tasks.
- Maintenance activities.
- Contingency plans.

Toolbox talks should include discussion on SIMOPS. These should cover the control measures and any potential conflicts or challenges.

Be aware of critical phases of activities that may be compromised by SIMOPS, e.g. topping-off cargo and bunker operations at the same time, Ship to Ship (STS) operations while alongside a berth working cargo (double banked).

Wherever possible, SIMOPS should be avoided if they may affect safety.

Refer to section 4.6 for further guidance on the topic.

9.9 Hazards on ships with exposed transverse frames

9.9.1 Manifold platform

The design of product and chemical tankers has evolved, leading to external transverse stiffening on the tank deck. The deck areas of these tankers are more cluttered and less accessible in some cases.

Extra elevated platforms are needed to access key work areas such as the manifold.

The manifold working platform has steel grating and, usually, a drip tray/saveall. Sometimes this platform is higher than two metres and may not have effective edge protection. Where fitted, edge protection may be temporarily removed to allow a hose connection. This risk of falling from height means adequate safety precautions are needed.

Given the hazards of working on these platforms, the work should be properly planned and effectively supervised. Personnel supervising the work should assess the suitability and safety of the platform. Work management should include a detailed risk assessment that covers the weather, training, fall protection devices and the slip/trip hazards and evaluates the edge protection.

9.9.2 Sampling and measurement points

On ships with deck transverse stiffeners, access around the deck in general, and to sampling and measurement points in particular, can be difficult. Wet or bad weather could pose additional hazards. Escaping from these areas in an emergency could also be challenging.

Safe access to sampling and measurement points is needed. Consider the following:

- Arranging safe access to the sampling and measurement points.
- The danger of creating semi-enclosed spaces with deck frames, which can be difficult to ventilate or may trap cargo vapours in light winds.
- Emergency access and exit for personnel wearing breathing apparatus and other restrictive equipment.

9.10 Repairs at a facility other than a shipyard

9.10.1 Introduction

This section deals with repairs on board a tanker at a facility other than a shipyard. It supplements but does not replace the guidance elsewhere in this publication. Guidance for when a ship is at a shipyard is provided in OCIMF's *Health, Safety and Environment at New-Building and Repair Shipyards and During Factory Acceptance Testing*.

9.10.2 General

When a ship is at sea or in port, the crew carry out their duties in line with the ship's SMS. When a ship is at a shipyard it is not operational and the work is carried out and managed primarily by the shipyard. While the ship's crew may monitor this work, the safety of the ship and anyone on board generally depends on the shipyard's SMS. Occasionally, an operational ship will need to carry out repairs using shore labour outside a shipyard or dry dock facility. In these cases, the safety of all on board depends on the ship's SMS and so all work should be carried out in compliance with the SMS.

Repairs may be done while the ship is:

- At anchor.
- Alongside at a layby berth that is not normally used for cargo operations.
- Alongside a commercial jetty.
- At sea.

Such repair work is only done on an exceptional basis, but the scope of the ship's SMS should include the planned activities and the risks to the shore labour employed.

9.10.3 Supervision and control

The Master, Company Superintendent or other appointed person should maintain full control of the repair work. They should ensure that the ship is in a safe condition at all times and that all work is carried out in a safe and proper manner.

Specific procedures are needed when the ship is to be repaired in a 'dead ship' condition or when the electrical power is limited.

9.10.4 Pre-arrival planning

Before arriving at the repair berth, anchorage or other facility, the initial planning should consider the:

- Type and location of the berth or anchorage.
- Moorings – numbers, type.
- Condition of the ship, e.g. gas free or inert.
- Safe access, e.g. launch, gangway or other means.
- Port and ship security arrangements, including ship and port security level.
- Number of personnel involved, including contractors.
- Location of the work, e.g. engine room, cargo spaces, above deck, accommodation, etc.
- Facilities for slop or sludge disposal.
- Arrangements for permits and certification, including using a chemist where appropriate.
- Port or terminal requirements.
- Availability of main power or main engine(s).
- Emergency procedures on board and ashore.
- Availability of assistance, e.g. firefighting, medical, etc.
- Connection to shoreside services, e.g. water, power, etc.
- Weather.
- Draught and trim limitations (to avoid unnecessary ballast handling).
- Restrictions on smoking and other naked lights.

9.10.5 Mooring arrangements

When moored to a repair berth, the number and size of mooring lines should be adequate for all likely weather and tidal conditions.

An alternative power source should be provided for the deck machinery, whenever practicable, so that moorings can be adjusted if the main power is unavailable.

On repair berths, crane movements or other activity on the dock side may restrict the mooring pattern. Take such restrictions into account when planning the berthing.

Moorings should be clear of hot work areas or other locations where the lines may be damaged by the repair work.

When at anchor, using an extra anchor cable may be necessary, particularly if the main engine(s) will be unavailable at any time.

9.10.6 Shore facilities

Whenever practicable, the ship should be physically isolated from regular terminal facilities or berths where other ships are being worked.

If any repairs need to be done at the same time as cargo handling operations, the terminal management needs to give specific permission.

The Master should establish whether any significant operations involving other ships are to take place near the berth where repairs are being done, e.g. departures/arrivals, bunkering, fuel oil transfer, etc.

The Master should be familiar with any specific safety requirements of the facility and/or harbour authorities.

Safe access should be available at all times with appropriate guard rails and safety nets. The number of access points should allow the quick evacuation of everyone on board. The gangway should be monitored at all times and a watch should control access to the ship (see chapter 6).

Port security plans should be followed as appropriate. A security risk assessment should be undertaken (see chapter 6).

On a non-hydrocarbon berth where the ship is not gas free, place a sign at the foot of the gangway to say: 'Warning! This ship is not gas free'.

Contractors should advise the Master of the number and movement of workers on board each day during repairs.

Procedures for using cranes or other lifting equipment should be decided on arrival.

The ship and the facility should agree garbage disposal procedures. These should comply with MARPOL Annex V.

Emergency alarm signals should be agreed and, if possible, a drill held before repair work starts. Further drills should be arranged if the repairs should be extended.

Any restrictions on activities such as bunkering, storing or taking lube oils are to be agreed. Be aware of the potential risks of SIMOPS (see section 4.6).

9.10.7 Work planning meetings

Work planning meetings should be held before starting any work and on each workday. They normally involve representatives from the ship and all the contractors.

These meetings ensure that all personnel involved are aware of the daily schedule, the interrelation between contractors, areas of concern and any special precautions, including permit requirements and the method of control.

9.10.8 Permits to work

Permits should be issued for the relevant repair jobs, including any repairs by the ship's crew. In particular, permits (see chapter 4) should be issued for:

- Enclosed space entry.
- Hot work.
- Electrical isolation.
- Hazardous energy.
- Lock-out/Tag-out (LO/TO).
- Other hazardous tasks as in section 9.6.

Copies of all permits should be posted as necessary. The Person In Charge (PIC) of the operation should also keep copies.

All personnel involved should be made fully aware of the requirements of the work permit system and its benefits. They should also be advised of restrictions on starting work until the appropriate permit has been issued.

If contractors provide any tools or equipment, it should meet the tanker's SMS requirements for safety, condition and calibration.

9.10.9 Tank condition

Whether the ship is gas free will depend on the work being done and the port or facility regulations.

All cargo/ballast spaces should be tested for oxygen and hydrocarbon content. The person responsible for the measurements should include the condition of all tanks and void spaces within the gas hazardous/dangerous area on the certificate. Some port or facility regulations may require these measurements to be carried out by a certified chemist.

If a ship is required to be gas free, certificates should be issued daily as a minimum.

If cargo tanks do not need to be gas free and the ship is inerted, positive IG pressure should be maintained within the tanks at all times.

9.10.10 Cargo lines

When the tank condition is to be gas free, cargo lines on deck, in the tanks and in the pumproom, including those lines and pumps that have not been used for recent cargo or tank cleaning operations, should be thoroughly washed and drained. This includes any dead ends in the system.

As well as the cargo suction and discharge lines (including stripping lines), slop tank balance lines or similar fittings between slop tanks should also be cleaned and drained when preparing for repair work.

The hydraulic valve system should be isolated in a way that prevents unintentional operation of cargo valves during the work. Post appropriate notices and advise the people in charge of the relevant repair team(s).

9.10.11 Firefighting precautions

9.10.11.1 Fire water

Fire mains should be continuously pressurised, either by the ship's pumps or from a shore supply.

Agree a pressure for the fire main and maintain this at all times.

9.10.11.2 Fire patrols

Agree a procedure for fire patrols on board. Either the ship's staff or shore contractors can provide fire patrols. Each member of the patrol should be fully aware of the procedure for raising the alarm and the action to take in an emergency.

The fire patrol should constantly monitor any area where hot work is being carried out.

9.10.12 Safety Officer

The Master should appoint a dedicated Safety Officer to coordinate the permit and certification processes for the repair period. The Safety Officer should be fully aware of all duties and responsibilities.

9.10.13 Hot work

The following supplements and does not replace the guidance in section 9.4, which should be followed for any repairs involving hot work.

Hot work should be prohibited within or on the boundaries of cargo tanks, ballast tanks, slop tanks, bunker tanks, pumprooms and forward cofferdams, including the deck and ship's shell plating,

except when special preparations have been made before entering the berth or facility and all the special conditions have been met.

Use of electrical welding equipment should be controlled and correct earthing cables used. The welding current should not be returned to the transformer via the ship's hull.

No hot work should be done within 30m of any non-gas free space unless the controlling authority for the port has given specific permission.

Post notices to indicate the state of any tank or void space, e.g. whether it is either gas free and suitable for hot work or only safe for entry.

Suspend hot work immediately if any of the specific safety requirements agreed with the controlling authority cannot be met.

Tank pressures should be monitored to ensure that any hot work on or above the weather decks is stopped before the inert pressure reaches the relieving pressure of the Pressure/Vacuum (P/V) valves. If tank pressure needs to be released to the atmosphere, suspend all work until this operation is completed. Consider clearing the deck area of personnel during venting, especially when there is the possibility of toxic gas, e.g. H_2S. A new permit should be issued before resuming work.

9.11 Shipboard emergency management

9.11.1 General

The ISM Code requires the operator to establish procedures to identify, describe and respond to potential shipboard emergencies. This includes adequate manning to respond to emergencies while at sea or in port. This section provides guidance on meeting this requirement.

9.11.2 Tanker emergency plan

9.11.2.1 Preparation

Planning and preparation are essential for personnel to successfully mitigate potential incidents on board tankers. The Master and other officers should consider scenarios, e.g. fire in the cargo tanks, engine room or accommodation, somebody collapsing in a tank (see chapter 10), the ship breaking adrift from her berth and the emergency release of a tanker from her berth.

Although they will not be able to foresee every detail, walking through these scenarios will help to develop initial response plans that can be incorporated into shipboard training and exercises.

The following onboard information should be readily available:

- Type of cargo, amount and disposition.
- Location of other hazardous substances.
- General arrangement plan.
- Stability information.
- Firefighting equipment plans.

9.11.2.2 Emergency organisation

The operator and Master should ensure that manning levels, in terms of numbers and qualifications, are adequate for the safety and security of the ship and its crew, as specified in the ship's Safe Manning Document as issued by the ship's Flag State administration. It should be noted that the number of crew may need to be increased to support the current mission, trade patterns, need for additional security and operational requirements, STS lightering or sea conditions (including ice conditions).

At all times during the stay at a terminal, enough crew should remain on board to manage any emergency.

Establish an emergency organisation structure with clear mobilisation protocols to include raising an alarm, locating and assessing incident potential and identifying hazards to respond with manpower and equipment.

Planning an emergency organisation should cover four elements:

Command centre

One group should be in control of the response to the emergency, with the Master or the senior officer on board in charge. The command centre should have internal and external communication.

Emergency party

This group should assess the emergency and report to the command centre, advising what action to take and what assistance to provide, either on board or from ashore. It should be under the command of a senior officer.

Backup emergency party

This group should stand by to help the emergency party as instructed by the command centre and provide backup services, e.g. equipment, stores, medical services including cardio-pulmonary resuscitation, etc. (see chapter 10). It should be under the command of an officer. Medical services and equipment should be clearly identified on board and ashore to include the nearest hospital or clinic equipped to manage potential injuries, i.e. burns unit and other specialties.

Engineering group

This group should provide emergency help as instructed by the command centre. Its prime responsibility is to deal with any emergency in the main machinery spaces. It may need to provide additional manpower elsewhere. It should be under the command of the Chief Engineer or the senior engineering officer.

The plan should ensure that all arrangements apply equally well, whether the ship is in port or at sea.

9.11.2.3 Preliminary action

The person who discovers the emergency should raise the alarm and inform the duty officer about the situation before attempting to isolate and take initial response actions. Once the alarm is raised, the duty officer should activate the emergency organisation to gather at the designated assembly point and brief them on the situation. Crew members not involved in the initial response should stand by to assist as directed.

9.11.2.4 Ship's fire alarm signal

When a ship is in port, sounding the fire alarm system should be supported by a series of long blasts on the whistle, at least ten seconds each, or by some other locally required signal.

9.11.2.5 Fire control plans

Fire control plans should be permanently displayed in key positions, showing clearly for each deck the location and details of all firefighting equipment, dampers, controls, etc. When the ship is in port, these plans should be displayed outside the accommodation block for the benefit of shore based firefighting personnel.

9.11.2.6 Inspection and maintenance

Firefighting equipment should be ready for immediate use. It should be checked frequently, with dates and details of the checks recorded. Where appropriate, the equipment should be marked with these details. A Responsible Officer should inspect all firefighting and other emergency equipment and any maintenance work completed without delay.

9.11.2.7 Training and drills

The ship's crew should be familiar with the theory of firefighting in section 5.1 and should be instructed how to use firefighting and emergency equipment. Regular practices and drills will help ensure that personnel retain their familiarity with the equipment.

If an opportunity arises for a combined fire practice or 'table-top' drill with shore personnel at a terminal, the Master should make an officer available to show them the location of portable and fixed firefighting equipment on board. The officer should also inform them about any design features of the ship that may require special attention in a fire.

9.11.3 Action in an emergency

9.11.3.1 Fire on a tanker at sea or at anchor

Whoever discovers an outbreak of fire should immediately raise the alarm, indicating the location of the fire. The ship's fire alarm should be operated as soon as possible.

Any crew near the fire should use the nearest suitable extinguishing agent to attempt to limit the spread of the fire, to extinguish it and then prevent re-ignition (see section 5.3). If unsuccessful, their actions should quickly be superseded by the tanker's emergency plan.

Any cargo, ballast, tank cleaning or bunkering operations should stop immediately and all valves should be closed. Any vessel alongside should be removed.

Once all crew have been evacuated from the area, all doors, openings and tank apertures should be closed as quickly as possible and mechanical ventilation should be stopped. Decks, bulkheads, other structures near the fire and adjacent tanks that contain petroleum liquids or are not gas free should be cooled with water.

The tanker should be manoeuvred to stop the spread of the fire and to allow the fire to be attacked from windward.

9.11.3.2 Emergencies in port

Emergencies either on board or next to the tanker when in a port are covered in section 20.3. Any action taken will be the joint responsibility of the Master and the port or terminal authority.

9.11.3.3 Jettison of cargo

Jettisoning cargo is an extreme measure justified only for the purpose of securing the safety of a ship or saving life at sea. A decision to jettison should not be taken until all the alternative options have been considered. This should be discussed with shore management and port or coastal State authorities. Written approval should be obtained.

If it is necessary to jettison cargo, take the following precautions:

- Alert engine room personnel. Depending on the circumstances, consider changing engine room intakes from high to low level.
- Discharge should take place through the sea valve and, where possible, on the side opposite to the engine room intakes.
- Close all non-essential inlets.

- If the discharge needs to be from the deck level, rig flexible hoses to extend below the water surface.
- Observe all safety precautions for operations involving flammable gas in the vicinity of the deck.
- Broadcast a radio warning.
- Maintain records in relevant log books.

9.11.3.4 Follow-up

As soon as possible after an incident, review and identify potential gaps in contingency plans, response tactics and equipment with the response or emergency organisation. Also capture best practices and lessons learned for inclusion in plan upgrades or next revisions. Post response, an inventory of equipment should be conducted and supplies replenished, e.g. breathing apparatus bottles or spill response gear. Flush systems and conduct necessary maintenance, e.g. foam.